

Water Quality

Coastal Nonpoint Source Pollution Control Program

Development of the Virginia Coastal Nonpoint Source Pollution Control Program was initiated in the fall of 1992 in response to Section 6217 of the Coastal Zone Act Reauthorization Amendments of 1990. This statute requires that states with approved coastal resources management programs develop and implement coastal nonpoint source pollution control programs. Federal guidance issued in January 1993 specified management measures for sources of nonpoint pollution. These measures have to be implemented through state-enforceable laws and regulations in order for Virginia to continue to receive NOAA funding.

State laws and regulations in Virginia were assessed and reviewed for their applicability to guidelines issued by NOAA and EPA. A draft program document was submitted to NOAA and EPA in 1994. A series of public forums were attended by citizen and business groups, local and state representatives. Based on public input, and review comments from NOAA and EPA, a final program document was developed and submitted in 1995.

In August 1997, NOAA and EPA issued final draft findings and conditional approval for Virginia's Coastal Nonpoint Pollution Control Program pursuant to Section 6217 of the Coastal Zone Act Reauthorization Amendments of 1990. An Environmental Assessment was also released which assesses the environmental impacts associated with program approval and implementation. The Virginia program includes management measures for agriculture, forestry, urban development, marina and hydromodification nonpoint source categories, and for wetlands, riparian areas, and vegetated treatment systems.

The Commonwealth's proposed boundary for the 6217 management area was deemed sufficient to control the land or water uses that have or are reasonably expected to have a significant impact on Virginia's coastal waters. This boundary mirrors the coastal management area, Tidewater (as defined by Virginia Code), stretching from Arlington to Chesapeake and out to the Eastern Shore counties of Accomack and Northampton.

To receive approval of its program, Virginia will need to meet certain conditions, including 1) the development of a monitoring plan to assess over time the efficacy of a coastal nonpoint program, and 2) final development of certain program areas such as management of on-site sewage disposal, construction site chemical control and riparian restoration efforts.

Virginia Department of Conservation and Recreation

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September 1995

1992 Task 81, 1993 Task 81, 1994 Task 81,

1995 Task 81 & 83



Assessing Implementation of Water Quality BMPs by Marinas

Pollutant contribution from marina and boat operations represents only a small percentage of the total volume of pollutants being discharged annually into the Chesapeake Bay and its tributaries. Nevertheless, marinas are being increasingly scrutinized as potential problem areas due to their high visibility, their location at the land/water interface, the composition of pollutants common to marina and boat operations. Although a number of conservation agencies in the Commonwealth have regulatory authority over the various aspects of marina construction, oversight of day to day marina operations is not always clearly defined.

The study was conducted at 100 randomly selected marinas in the Tidewater area to investigate both the level and type of BMPs being used by marinas in the coastal zone. The primary focus of field investigations were on successful management practices to limit pollutant discharges. A survey was developed to gather site specific information regarding the current level of BMP applications, in-situ management measures, operator perceptions, and planned measures for further pollutant reductions. Marina operators were encouraged to discuss existing and planned BMP applications and indicate their preferences and opinions regarding the usefulness of various management measures in reducing discharges.

Most of the marina operations reviewed were in compliance with existing regulations issued by the Virginia Marine Resources Commission and the Virginia Department of Health, and were not far from achieving the nonpoint source pollution reduction goals of the Coastal Zone Management. Problems were found in the areas of boat maintenance and sewage pumpout.

Marina operators surveyed expressed the need for a marina extension agent who could provide technical expertise on existing and proposed regulations; assist marina managers in the development of stormwater protection plans, operating plans and BMPs for their facilities; and, who could coordinate marina trade organizations and regulatory agencies efforts to develop and implement a comprehensive boater education program addressing nonpoint source pollution control practices.

*Virginia Marine Resources Commission
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June 1996
1994 Task 83*



Drainfield Repair Resource Manual for Systems Failing in Virginia's Coastal Zone

The Drainfield Resource Manual, including a section funded by the Virginia Coastal Program, entitled The Systematic Evaluation and Repair of Failing Drainfields in the Coastal Zone, was developed to provide environmental health specialists with guidance on how to evaluate malfunctioning drainfields. The manual begins with methods to identify the causes of failure and how to evaluate the site for repair. It details long-lasting sewage system repairs that are cost effective and meet the needs of the public. The manual also contains supplementary materials on sand filters, low pressure systems and pressure irrigation drip disposal systems. Training classes were also held in 1991 and 1992 on drainfield failure, effective repair and advances in repair technology. The Drainfield Resource Manual is available on the Virginia Department of Health website at <http://www.vdh.state.va.us/oehs/onsite/training.htm>.

*Virginia Department of Health
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December 1992
1991 Task 14*



Evaluation of Urban NPS Pollution Control Alternatives

A range of innovative pollution prevention techniques was evaluated and compared to conventional techniques for nonpoint source management. Emphasis was placed on quantifying the effectiveness of these techniques for reducing urban nonpoint source pollution as they may be applied to the Four Mile Run watershed in Northern Virginia. The report produced quantifies the projected pollution prevention strategy alternatives for ten pollution prevention alternatives, and also provides cost information and projected cost-benefit rates for some of these alternatives. Results of this study are generally transferable for use by other urban localities, and all study methodologies are documented to facilitate replicability.

*Northern Virginia Planning District Commission
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February 1997
1995 Task 65*



A PC-Based Tidal Prism Water Quality Model for Small Coastal Basins and Tidal Creeks

An existing water quality model of small coastal basins and tidal creeks was refined and expanded to better simulate eutrophication processes and to be compatible with modeling efforts in main bay and major tributaries. The goal of the project was to provide, test, and demonstrate a generic water quality model for use by resource management agencies.

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September 1994
1993 Task 13*



Field Studies in the Lynnhaven R. for Calibration of a Tidal Prism Water Quality Model

The purpose of this project was to collect water quality data in the Lynnhaven River of Virginia Beach for calibration of the Tidal Water Quality Model which was developed under Task 13 in 1993. The Tidewater Regional Office of the Department of Environmental Quality has monitored the Lynnhaven River bi-monthly since 1975. Funding enabled the collection of supplemental data for purposes of evaluating critical parameters indispensable to model application.

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January 1995
1993 Task 25*



Application of a Tidal Prism Water Quality Model to the Lynnhaven River

The Tidal Prism Model developed in 1993 was applied to the Lynnhaven River of Virginia Beach. It was demonstrated that the model can successfully simulate the eutrophication processes in the small coastal basins and tidal creeks. Two workshops were conducted to introduce the model to resource managers and regulatory agency personnel. A software package of the model was developed and made available to users. The agencies are actively pursuing opportunities to use the model for nutrient reduction strategies.

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September 1995
1994 Task 19*



Modeling Cumulative Impacts and the Carrying Capacity of Small Tidal Creeks and Inlets

The purpose of this project was to identify pollutant loading values which might be used as input for a series of water quality models applied to small tidal creeks and inlets in Virginia's coastal plain. The intent was to identify values from literature sources which might be used in application of the models, absent better or more specific information. Estimates of biological oxygen demand, chemical oxygen demand and fecal coliform loadings were of specific interest.

This report provides a summary of values for both runoff coefficients and storm water runoff load estimates for total suspended solids, biological oxygen demand, coliform levels, chemical oxygen demand, total nitrogen and total phosphorus.

*Virginia Institute of Marine Science
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July 1995
1993 Task 19*



Water Quality

Man Versus Mollusc: Studies of Water Quality Problems, How They Affect Shellfish and Shellfish Harvesting, and How the Commonwealth Should Address These Problems

The purpose of this study was to investigate the problem of water quality degradation and its effects on the shellfish industry, and make recommendations regarding the state's management of water quality and shellfish resources. Sources of point and nonpoint pollution potential were analyzed, with particular emphasis on bacterial pollution in the Chesapeake Bay watershed area. Several case studies illustrate the problem of water pollution in terms of human population growth and development, and the problems and trends encountered by other coastal states. This report recommends: establishing a program to designate "Shellfish Culture Areas"; promoting alternative methods of shellfish cleansing; and, reducing pollutant sources, especially sources of fecal pollution. Also discussed are more detailed recommendations to protect Virginia's shellfish growing areas and promote the shellfish industry.

*Shellfish Enhancement Task Force
Virginia Institute of Marine Science
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December 1991
1990 Task 14*



Anaerobic Pretreatment & Removal of Nutrients and Ammonia from Crab Processing Wastewater

The blue crab industry is one of the largest seafood processing industries in Virginia, and handles several million pounds of blue crabs each year. The industry is an important economic and cultural component of Virginia, but many of these small companies discharge wastewater that is high in biologically degradable matter directly into nearby water bodies. In order to maintain the quality of coastal waters, inputs of nutrients, which serve to accelerate eutrophication, and ammonia, which can cause toxicity problems, are being strictly regulated. Crab processing waters contain high levels of nutrients and ammonia, and therefore need to be treated rigorously before direct discharge to the environment. Access to municipal wastewater treatment plants for processing these waters is currently nonexistent to rural processing plants and may not be guaranteed in the future to those plants in municipal areas. Without appropriate options for wastewater treatment, many crab processing companies, and the individuals and businesses that rely on them, may be in danger of economic hardship or failure.

The objective of the first phase of these two projects was to design and test a treatment system that would be affordable and manageable for small processing companies but capable of removing high levels of oxygen-depleting substances and suspended solids. The Phase I report presents and discusses preliminary results from a bench-scale system.

The Phase II report rigorously analyzes a pilot plant in Hampton, Virginia. The Phase II report evaluates the use of an anaerobic process in series with ammonia stripping and/or an aerobic/anaerobic process for nitrification-denitrification of these crab processing waters.

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February 1994, November 1994
1992 Task 24, 1993 Task 21*



Water Quality

Nutrient Limitation in the Chesapeake Bay: Nutrient Bioassays in the Virginia Bay System

The purpose of this research was to extend the investigations of the role of nitrogen and phosphorus in controlling the abundance of algal biomass in the Virginia portion of the Chesapeake Bay system. Eutrophication resulting from anthropogenic inputs of nutrients is increasingly recognized as having a deleterious impact on water quality in the Bay and its tributaries. Potential or actual effects from over-enrichment with nitrogen and phosphorus include: a change in the phytoplankton species constituting the base of the food web with possible implications for the nature of the food web and harvestable sources; a decline in submerged aquatic vegetation resulting from reduced sunlight penetration by increased phytoplankton and epiphyte abundance; and, the exacerbation of hypoxia and anoxia in deep waters of the Bay resulting from increased phytoplankton abundance which is transported to the bottom waters and sediments and depletes oxygen during decomposition.

On the basis that scientifically sound and cost-effective nutrient management strategies in the Chesapeake Bay require a better understanding of the spatial and temporal patterns of nutrient limitation of phytoplankton growth, this study examined nutrient limitations at six stations in the lower Bay and its tributaries (Rappahannock and James Rivers, and the mainstem of lower Bay), which complemented similar studies that were underway in the York River and Maryland portion of the Bay.

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March 1993
1991 Task 15



Virginia Citizen Water-Quality Monitoring Program

The Virginia Department of Environmental Quality, Chesapeake Bay Office, coordinates Virginia's Chesapeake Bay monitoring program and activities. The *Virginia Citizen Water Quality Monitoring Program*, a network of citizen volunteer monitors, established by the Alliance for the Chesapeake Bay in 1985, is an important component of the Commonwealth's Chesapeake Bay monitoring activities. Citizen volunteers play an valuable and cost-effective role in monitoring efforts in the Bay watershed and coastal waters. The Alliance manages a network of approximately 110 citizen water quality monitoring volunteers at close to 75 sites in the tidal portions of all the major Virginia tributaries to the Bay. In addition to collecting water quality indicator data, volunteers also make wildlife observations. Data gathered by these volunteers is used in Virginia's biennial report to Congress on the status of water quality, and reported to the EPA's Bay Program Office.

*Alliance for the Chesapeake Bay, Virginia Citizen
Monitoring Program/*

Virginia Department of Environmental Science

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December 1990, November 1991,

December 1993, September 1995

1989 Task 4, 1990 Task 6, 1991 Task 6, 1994 Task 24



Phytoplankton are tiny one-celled plants often occurring in colonies known as algae.

Groundwater Transport of Fecal Coliform Bacteria to Open Coastal Waters of Virginia's Coastal Plain: A GIS Approach

Fecal coliform data sets were analyzed using computerized spatial analysis (GIS) and statistical methods. Sixteen of Virginia's 21 coastal counties exhibited statistically significant increasing fecal coliform bacteria levels.

The data encompasses the time period between 1981 and 1992, and incorporates 2,614 sampling stations and some 191,910 individual measurements. While the primary focus of this study was to investigate the linkage between groundwater discharge and elevated fecal coliform levels in adjacent surface waters using a GIS approach, the available fecal coliform data set and collection methods were not designed for this detailed analysis. Using the best available data for Virginia's Eastern Shore, the significance of several groundwater parameters (hydraulic gradient, soil permeability, Darcy velocity) and urban nearshore land use suggest that on-site wastewater disposal may be related to elevated fecal coliform densities. This observation, however, should be treated with caution given the low overall significance of the regression. Visual observation of the data exhibited the general trend of increasing fecal coliform densities with distance upstream tidal creeks and inlets. The trend was consistent for all major tributaries and Virginia's Eastern Shore. A "land mass" factor provided the strongest correlation with water column fecal coliform levels as compared to other environmental and computer parameters. Low fecal coliform levels were correlated to winter sampling, sampling under the influence of low precipitation rates, high-tide conditions, and high salinity.

Virginia Polytechnic Institute and State University

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April 1994

1992 Task 11



Groundwater Transport of Fecal Coliform Bacteria and Nutrients from Residential On-Site Wastewater Disposal Systems to Virginia's Coastal Plain

This study was conducted to evaluate water quality impacts of groundwater discharge from residential land uses utilizing on-site wastewater disposal systems (OSWDS's) to coastal waters of Virginia. The objectives of this study were to: 1) to investigate the transport of fecal coliform bacteria from residential lands using OSWDS's to adjacent surface waters; 2) to provide data on nearshore sediment nutrient flux adjacent to residential land use utilizing OSWDS's; 3) to examine the prevalence of "false positives" in the standard gas production assays; and, 4) to assess the potential of a simplistic GIS approach to target high-risk shorelines that could benefit from OSWDS improvement or implementation of best management practices.

Shoreline groundwater inorganic nitrogen concentrations were approximately two orders of magnitude greater than adjacent surface waters, and inorganic phosphorus values were three-four fold or greater. Nearshore sediments adjacent to residential land uses represented an overall source of DIN and DIP to surface waters; mean DIN fluxes were comparable to those reported for agricultural lands. While OSWDS drainfield fecal coliform densities were generally two or three orders of magnitude greater than surface waters, shoreline groundwater fecal coliform bacteria densities were consistently low, and in most cases near the method detection limit. Sediment released greater densities of fecal coliform bacteria when subjected to stimulated ground-water flow than cores collected in regions not under the influence of OSWDS drainage. This result suggests that supplemental substance inputs, such as nutrients and organic carbon, may be responsible for elevated fecal coliform densities and greater survivability in nearshore sediments under the influence of OSWDS drainage.

Virginia Polytechnic Institute and State University

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March 1995

1993 Task 20



An Investigation of the Feasibility of Testing One or More Alternative On-Site Sewage Treatment Systems in the Richmond Region

In Virginia, 650,000 year-round housing units use on-site sewage disposal systems, many of these in rural areas. A majority of these homes use conventional septic tank/drain field systems. There are, however, many potential building sites that are not suitable for these systems. The goal of this report was to investigate the reasons that cause conventional systems to fail. In addition, the report examines three alternatives to these systems: low pressure distribution systems, elevated sand mounds and constructed wetlands. Based on interviews with individuals from the Virginia Department of Health, Virginia Polytechnic Institute & State University and others, the need for more investigation of the potential for use of these systems was determined. Specifically, more information is needed about how these systems function in the various soil and water table conditions in the Virginia coastal plain. The report recommends a test methodology for these systems including costs and financing options.

Richmond Road Planning District Commission
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November 1993
1992 Task 34 (Coastal Technical Assistance Program)



Tyler's Beach Sanitation Unit

The Tyler's Beach Boat Harbor is situated on the western Shore of the lower James River in Isle of Wight County. This facility is used primarily by a group of commercial fisherman who work the lower James River. In 1996, the Virginia Marine Resources Commission reconstructed and added an extension to the pier. In order to bring the pier into compliance with the Virginia Department of Health's Regulations for Marinas and Boat Moorings. Isle of Wight was required to purchase a portable sanitation unit to be located at the site of the pier.

Isle of Wight
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December 1996
1995 Task 2.6



Laundromat Wastewater Treatment

This report reviews alternatives for treatment and disposal of wastewater from five Eastern Shore Virginia coin-operated laundromats. This project was a result of a VPDES permit compliance schedule from the Virginia State Water Control Board, which required four of the five laundromats to cease stream discharge by August 1992.

Accomack-Norhampton
Planning District Commission
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May 1992
1991 Task 38



Wetlands help purify water by filtering out nutrients, wastes, and sediment from runoff and floods. (from VIMS Wetlands Program *Technical Report*, 1991 No. 91-A) See: Public Education, page: *Wetlands Newsletter & Technical Reports*

Suitability of Precision Farming Technology in Virginia's Coastal Zone

This purpose of this study was to evaluate the potential success of precision farming in the Coastal Zone of Virginia. Studies were performed at eleven sites within the Coastal Zone to quantify the spatial variability in soil chemical parameters; determine the optimum sampling strategies; evaluate impacts of precision farming on surface water quality; and compare economics of precision farming and conventional farming systems.

The soil chemical parameters (P, K, and pH) exhibited substantial spatial variability within each field as well as among various sites. In general, P values had the highest degrees of variabilities, compared to K and pH at each sites. Study results showed that the number of soil samples needed under precision farming depends on the confidence level and the expected deviations around the actual mean value of a soil parameter. More soil samples are required at higher confidence level and at smaller deviations around the actual mean values. Further, analysis indicated that the parameters with higher coefficient of variation (CV) were found to have smaller soil sampling intervals compared to those with lower Cvs. Due to practical and cost considerations, it may not always be possible to adopt different sampling intervals for different parameters. Therefore, for the region, a sampling interval of 328 ft. is suggested for adequate characterization of P, K, and pH levels.

The fertilizer rate required under precision farming would be approximately the same as under the uniform application system, but the fertilizer input distribution within a field would be different under the precision farming system. The spatially different distribution of fertilizer would prevent under- and over-application of fertilizer, and hence would improve fertilizer use efficiency. Results of AGNPS model, interfaced with the GIS, indicated a 12-25% reduction in N losses to surface water under precision farming, compared with the conventional farming system. However, further research needs to be conducted using continuous NPS model, which has crop growth and production components. Further study showed that precision farming produced higher net profits than the conventional farming system. The net profits under the precision farming increased with increased corn grain prices. Results also indicated that to demonstrate the profitability of precision farming, corn output analysis should be conducted along with fertilizers input analysis.

This study demonstrates the potential benefits of the precision farming over the conventional farming systems. The N losses in surface water could substantially be reduced if precision farming is implemented in the field. The benefits of precision farming could be achieved only when an improved fertilizer application technology capable of applying variable rate would become available to farmers. However, results indicate that precision farming technology has great potential for improving the environmental and economic benefits in the Coastal Plains of Virginia.

Virginia Polytechnic Institute and State University

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February 1997

1995 Task 72



See Also:

Shoreline Management, page 82:

*Hydrodynamics of Sediment Suspension in the Littoral
Zone of the York River*